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the nature of psychic functions. The value of the book is enhanced by a chapter describing the process of learning to see in those who, born blind, have been restored to sight.

J. JASTROW.

Physiologische Studien über Psychophysik. Von DR. FRANZ CARL MÜLLER. Archiv. für Anat. u. Physiol., Heft III. u IV. 1886.

This third German investigator of his name in the field opened by Weber's law, attempts to determine how the negative variation needful to excite a just observable contraction is related to absolute intensity of the [ascending] current. For this purpose a single pair of unpolarized electrodes served for the permanent and for the reversing current in such a way that when the contact was closed the currents were separated and compensated; when it was open they combined, causing a negative variation. The sciatic nerve of a frog was first observed, and the minimal contractions of the toe-muscles directly observed. The quotient of the intensity of the larger current (measured in divisions of the current passed over by the needle of the galvanometer), divided by that of the variable current, here measures the psychophysics relation sought. This quotient begins in feeble currents with a threshold intensity of unity, and increases rapidly to two or three times its initial value, and then remains constant for a time, till with very strong currents it sinks again. Although the first period of increasing differential sensibility is quite analogous to the lower limit of Weber's law, the second period of constant quotients, the extent of which differs for different nerves, is especially important. Very similar results were attained on rabbits and guinea pigs. Percutaneous stimulation by the same method on the motor points of various digital muscles in the human arm, gave results with somewhat greater irregularity, but with a long second period of constant quotients. Next, instead of just observable muscular contraction, just observable differences of sensation were attempted with similar results. From these experiments Dr. Müller feels himself justified in calling Weber's law only one [psycho-physic] case of a larger "neuro-physic" law which applies to all stimuli that diminish excitability, and formulates his law as follows: "The excitation caused by a change of intensity of a stimulus that diminishes excitability remains the same (under conditions otherwise similar and within certain limits of absolute intensity of stimulus), if the relation of the change of intensity to the intensity on the basis of which the change is made remains the same. Outside these limits, with constant relation between intensity and change of intensity from one degree of stimulus to the next higher, an increase of excitation occurs with small, and a decrease with great intensity."

A sensation of difference which Fechner substituted for Weber's difference of sensation, is not a sensation at all, but a judgment. A sensation due to a constant stimulus is physiologically a state of diminished excitability. Changed excitability is thus an essential property of sensation which serves as an index to the inner dynamic, or neurotonic state of the nerve. The act of bringing two sensations, or even the memory of two past sensations into relation, or comparing them by alternating from one to another, is the simplest form of any judgment, and is physiologically represented by

excitation attendant on the transition from one state of excitability to another. As a state of reduced excitability, the psycho-physic process that underlies sensations is thus directly proportional to the intensity of the stimulus. By using as his stimulus the change from anelectrotonus to katelectrotonus, and correcting for the movement of the indifference point along the myopolar tract, Müller was able to study states of increased excitability, and the effects of transition from reduced to increased excitability, although in a preliminary way, respecting which fuller results are promised. His work is in the line of Dewar and McKendrick, Bernstein and Ward, indicating that the sensation is directly as nervous action, and that the logarithmic relation holds between the stimulus and the amount of neural excitation. He attempts, however, to subsume Fechner and Weber under the law of stimulation by changed electrotonic state. The author's fuller results will be awaited with interest.

Untersuchungen über das Tongedächtniss. Von H. K. WOLFE.
Wundt's Philosoph. Studien. III. 4.

Dr. Ebbinghaus studied the function of memory as a reproductive faculty by counting the number of repetitions of a variable series of nonsense syllables, necessary to enable the learner to repeat them at will after a given interval, also subject to variations. Mr. Wolfe's study is upon memory as a recognizing faculty; evidently an easier and more extended power. In a second reading of a book, for example, we recognize as familiar much more than we could have repeated of the contents. The author used a series of nearly three hundred vibrating metal tongues, giving the tones through five octaves, and proceeding by intervals of two vibrations in the two lower, and of four vibrations in the three higher octaves. In the different series of experiments, certain of these tones were chosen as standards, and after sounding one of them for one second, a second tone, either the same or one differing from it by four, eight or twelve vibrations (higher or lower), was sounded at a variable interval, and the subject was required to say whether the second tone was the same or different from the first, and if different, whether higher or lower. Besides the answer could be "undecided," and also "different but undecided whether higher or lower." By adopting such a cumbrous method, and allowing the subject as many as five kinds of answers, Mr. Wolfe has very much diminished the value of his tables. For example, one of his strongest points is that we can tell whether two tones are equal more accurately than whether they are different. This does not at all follow from his tables. When the subject said "higher" or "lower," and was wrong, it may have been that the tones were really *different*, and thus the subject was only half wrong; *i. e.*, he recognized the difference, but not the direction of the difference. If we thus add the number of cases in which the direction of the change was recognized to the number in which the difference only was recognized, and estimate how many of the cases in which the direction of the change was misjudged, the fact of a change was recognized (on which point the tables are silent) as only one-half, it looks very much as though this statement did not hold. It is an excellent example of the mischievous effect of a poor method of experimenting or of stating one's results.